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QoS Provisioning for Wireless Cellular Network

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***Abstract*-The 3G wireless cellular networks provide the multimedia communication that can be enjoyed by the user any time anywhere..Call Admission control in wireless cellular network is to guarantee Quality of Service(QoS) this is a challenging issue for the wireless network due the mobility of user. The design of call admission control algorithms for mobile cellular networks is especially challenging given the limited and highly variable resources, and the mobility of users encountered in such networks This paper proposed a CAC algorithm for three types of call classes voice, data and video. In our proposed algorithm we have divided the call of a cell into newly generated call and handoff call. Handoff call is given more priority than newly generated call in the network .we calculate the new-call and handoff-call blocking probabilities. The analytical results are verified through simulation and found to be absolutely satisfactory.**

***Key Words*— CAC, QoS, WCDMA,3G**

1 INTRODUCTION

The third generation (3G) technology is a developing technology for the future mobile communication. Nevertheless, along with the development of the third generation (3G) mobile technologies, the development of the consumer electronics will also grow. The third generation (3G) services add a valuable mobile dimension to services that have already become an integral part of modem life, such as the internet and intranet access, and video-conferencing. With the support of higher data transmission rate for mobile users, third generation (3G) networks are expected to support different broadband multimedia services, and hence, leading to the increasing provision of the products for consumer electronics, like video mobile phones and third generation (3G) broadband cards.

Apart from the appearance of the products, a key factor that most end users concern is the diverse quality-of-service (QoS) requirement of the system. In other words, the network performance will affect the market of the products in consumer electronics, indirectly With the development growth of the internet and dramatic increase in wireless access, there is a tremendous demand on multimedia delivery over wireless internet. The third generation (3G) wireless cellular networks, foreseen to be the enabling technology for multimedia services with up to 384 kbps outdoor and 2 Mbps indoor bandwidth, makes it feasible for visual communication over the wireless link. Error rate is usually very high in wireless channel, which is caused by multi-path fading, inter-symbol interference, and noise disturbances. The channel error rate varies with the changing external environment, resulting in devastating effect on multimedia transmission/applications Call admission control (CAC) techniques must be introduced to guarantee that air traffic types meet their quality of service (QoS) requirements. These are techniques that control the acceptance of different types of calls into the system. The necessary quality of service (QoS) is guaranteed in term of both call dropping and call blocking probabilities. A call admission control (CAC) strategy may block additional calls even if there are enough resources for the service in order to improve the systems fairness. Call admission control (CAC) is based on the knowledge of the statistical characteristics of ongoing and arriving calls. The decision to accept an additional call involves the calculation or estimation of the consequences of the call acceptance on blocking and delay of itself and other incoming calls.

Call admission control (CAC) is one of the key elements in ensuring the quality of service (QoS) in mobile/cellular wireless networks. The traditional trunk reservation policy and its numerous variants give preferential treatment to the handoff calls over new arrivals by reserving a number of radio channels exclusively for handoffs. Such schemes, however, cannot adapt to changes in traffic pattern due to the static nature

2 RELATED WORK

This provides a survey of admission control schemes for wireless cellular networks. Our goal is to provide a broad classification and thorough discussion of various existing call admission control (CAC) schemes. The classifications of these schemes are based on factors such as deterministic/stochastic guarantees, distributed/local control and adaptivity to traffic conditions.

The discussion done by R. Jayram, N. K. Kakani, S. K. Das & Sanjoy K. Sen, in their paper titled “Call Admission & Control Scheme for QoS Provisioning in Next Generation Wireless Networks”. They proposed a framework for low layer (e.g. radio link layer) QoS Provisioning in next generation wireless networks. Salman AlQahtani and Ashraf S. Mhmoud developed an algorithm for wireless networks in their paper titled “A QoS-Aware Call Admission Control Algorithm for 3G Cellular Wireless Networks”. Their call admission control (CAC) scheme gives preferential treatment to high priority calls, such as soft handoff calls, by reserving some bandwidth margin (soft guard channel) to reduce handoff failures. .Yi Zhang and Derong Liu, discuss about algorithm for call admission control (CAC) in their paper titled “An Adaptive Algorithm for Call Admission Control in Wireless Networks”. Their algorithm is built upon the concept of guard channels and it uses an adaptation algorithm to search automatically the optimal number of guard channels to be reserved at each base station. The paper titled “Call Admission Control Schemes and Performance Analysis in Wireless Mobile Networks” by Yuguang Fang & Yi Zhang, point out that when the average channel holding times for new calls and handoff calls are significantly different, the traditional one-dimensional Markov chain model may not be suitable; two-dimensional Markov chain theory must be applied Novella Bartolini, Imrich Chlanitac, addresses the call admission control problem for the multimedia services that characterize the third generation of wireless network in their paper titled “Call Admission Control in Wireless Multimedia Networks”. Their model is exploited to evaluate the behavior of a wide class of policies and is optimized by means of stochastic analysis with SMDPs. SMDPs can be used to optimize blocking probabilities of new and handoff calls of several classes of multimedia requests. Chi-jui Ho and Chin-Tau Lea, presents a modified Linear Programming approach to find better call admission control policies to maximize the utilization under constraints on handoff and new call blocking probabilities in their paper titled “Finding Better Call Admission Policies in Wireless Networks”. Authors found that policies shows a gain of about 6% - 32% compared with complete sharing policy and a gain of about 0.02% - 7% compared with best guard channel policies. This approach can be extended to find better call admission control policies for the wireless network with multirates or with buffers AbdulRahman Aljadhai’Taieb F. ZnatitTs presented a framework for predictive timed-QoS guarantees based on a mobility mode1 that estimates the cluster of cells that are most likely to be visited and the time interval during which these cells are visited. A distributed call admission control which verifies the feasibility of admitting new and hand-off calls was also described. The paper titled “Genetic Algorithms Applied to Cellular Call Admission Local Policies” by Aylin Yener, Christopher Rose; define local call admission policies that make admission decisions based on partial state information. Authors search for the best local call admission policies for one-dimensional (1-D) cellular networks using genetic algorithms and show that the performance of the best local policies is comparable to optima for small systems. They test their algorithm on larger systems and show that the local policies found outperform the maximum packing and best handoff reservation policies for the systems find that the local policies suggested by the Genetic Algorithm search in their cases are double threshold policies Authors then find the best double threshold policies by exhaustive search for both 1-D and Manhattan model cellular networks and show that they almost always outperform the best trunk reservation policies for these systems.

3-SYSTEM MODEL

The call is divided into three classes: (1)Voice call (2)Data Call (3)Video call. All the call is generated into 16 sub classes as follows:1.Voice Hand-Off, 2 .Data Browsing & Download Hand-Off, 3 .Data Audio & Video Streaming Hand-Off,4. Data Multiplayer Games Hand-Off, 5 .Data Text Chat / Instant SMS

Hand-Off, 6. Data Images & Multimedia Messeging Hand-Off,7.Video Telefony Hand-Off, 8.Video Conferencing Hand-Off,9.Voice New Call, 10 .Data Browsing & Download New Call, 11. Data Audio & Video Streaming New Call,12. Data Multiplayer Games New Call, 13.Data Text Chat / Instant SMS New Call, 14.Data Images & Multimedia Messeging New Call,15.Video Telefony New Call,16 .Video Conferencing New Call. In our system call is randomly generated.

LOAD ESTIMATION IN WCDMA SYSTEMS

To implement the admission control for WCDMA systems, first an estimate of the total interference should be computed to be employed in the decision process of acceptance or rejection of new connections. In this section the uplink capacity and load estimation of a homogenous, uniformly loaded network will be presented. The analysis carried out will focus on the UTRA–FDD mode. Furthermore, the analysis assumes perfect power control operation. Hence, a mobile station (MS) and its home base station (BS) use only the minimum needed power in order to achieve the required performance. The CDMA capacity has been subject to extensive research work, hence only a short description is given here. The value of the bit-energy-to-noise-density ratio Eb / No corresponds to the signal quality, since it determines the bit error rate, BER. Let ρ be the target bit-energy-to-noise-density ratio required to achieve a particular BER, or equivalently a particular frame error rate (Eb / No≥ ρ). That means the maximum bit (BER) or blocks (BLER) error rates, can be mapped into an equivalent Eb / No constraint denoted by ρ .

$\left(\frac{W}{R_i}\right) = G_i$: is the spreading factor for processing gains of MS i

R_i:Bit Rate of MS i

W:The chip rate of WCDMA(3.84 Mcps)

ρ_i =The require E_b/N_0 for the mobile I and for a certain service quality

$\Delta\eta_i$ called load factor increment for the new user i

$$\Delta\eta_i = \frac{1}{(\frac{G_i}{\rho_i} + 1)} \qquad (1)$$

The total load factor η of such an interference system is the sum of the load factor increments brought by N active mobile users. Therefore

$$\eta = \sum_{i=1}^{N} \Delta\eta_i \qquad (2)$$

4 ASSUMPTION

This section provides a brief description of the system under study. The throughput-based CAC algorithm computes the increase in the load caused by the uplink admission of a new user in the cell $\Delta\eta_i$ and accepts the new connection only if the following inequality is satisfied,

$$\eta_i + \eta \leq \eta_{Thr.i} \qquad (3)$$

Where $\Delta\eta_i$ is the current uplink load of the cell and $\eta_{Thr.i}$ is the uplink load threshold. We consider a single cell in a homogenous and uniformly loaded network. Since the network is assumed to be homogeneous, the performance of the system can be anaysed just from the performance of a single cell analyzed in isolation. Three types of services are considered, voice, data and Video. Each type has two classes, newly originating calls and soft handoff calls. The soft handoff calls have higher priority than new calls. The system contains a separate queue for each handoff calls type . The system model is depicted in Figure 1

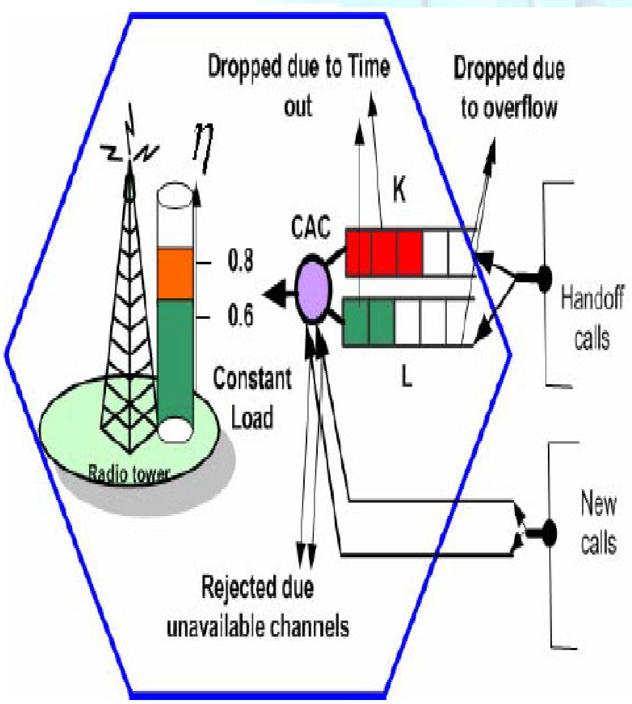


Figure1: Detailed Cell Model

The arrival process of new and handoff calls is Poisson with rates, λ_{h1} λ_{h2} $\lambda_{h3}\lambda_{hn1}$ λ_{hn2} λ_{hn3} for voice handoff call , data handoff calls, video handoff, voice new calls and data new calls, and video new call respectively. The channel holding time for each type of calls is exponentially distributed with mean μ^{-1}while the queuing time of each handoff calls class is exponentially distributed with mean γ^{-1} . This algorithm has the following steps:

When a call arrives in a cell, load factor threshold for new and handoff calls η_{Thr} and QoS requirements (in term of BER) are determined firstly. Then the load increase of the arrived call and the current cell load factor before accepting the arrived call are calculated, η_{new} new . After calculating the current load of the target cell η_i , it is compared with the load factor threshold of the arrived call of type $\eta_{Thr,i}$ If the current cell load factor plus the load increase is less than or equal the required load factor threshold for the arrived call, then the arrived call can be admitted to enter the target cell. Otherwise, the arrived call is queued or rejected based on queue availability. Queued soft handoff calls can be accepted if sufficient bandwidth gets available, or can be terminated due to timeout.

Table 1:- Simulation Perimeters

Parameter	**Value**	**Parameter**	**Value**
Radio acess mode	WCDMA (FDD)	Activity of users	voice = 0.4; data = 1; video = 1
service Classes	1. Video 2.Voice 3. Data	Fractional load is 65% and reserve 35% for hand off calls	thremax_new = 0.65; thremax_hand = 1.0
sub classes	a. Hand off b. New	Interference factor (f)	Interference factor = 0.5
Priority	1. Video hand off 2. Voice hand off 3. Data hand off 4. Video new call 5. Voice new call 6. Data new call	Thermal noise	Thermal noise = 1.0e-15
Bit rate	voice =12.2 databrow =128 dataavstre = 28.8 datamplay 128 datatext = 10 datamms = 64 videotele = 64 videoconf 144	Channel holding time	180 sec
Required Eb/No	voice = 5.6 Data = 4.4 video=3.2	Queuing limit (Handoff Call)	Voice =5ses,Data =5sec Video =5sec
Chip rate	3.84Mbps	Call Percentage	Data=50 Voice=30 Video=20

5-SYSTEM PERFORMANCE

This proposed Algorithm is evaluated based on three Quality of Service (QoS) metrics: The blocking probability for newly originating calls, the forced termination probability and the total system carried traffic. The blocking probability is the probability that a new call is denied access to the system, while the forced termination probability is the probability that a call that has been admitted will be terminated prior to the call's completion. The Grade of service is considered here to evaluate the system performance and defined as:

$$QoS = \alpha * P_{hb,i} + P_{nb,i} \quad (4)$$

Where $P_{hb,i}$ is the handoff blocking probability, and $P_{nb,i}$ is the new call blocking probability of calls belonging to traffic of type i.α =10 . Which indicates priority level for handoff call to new call. Smaller QoS means better system performance. The system capacity is evaluated using the total carried traffic (i.e., rate of call departure), so as the total carried traffic increase the system capacity in term of supporting more calls increases. The total carried traffic is evaluated using:

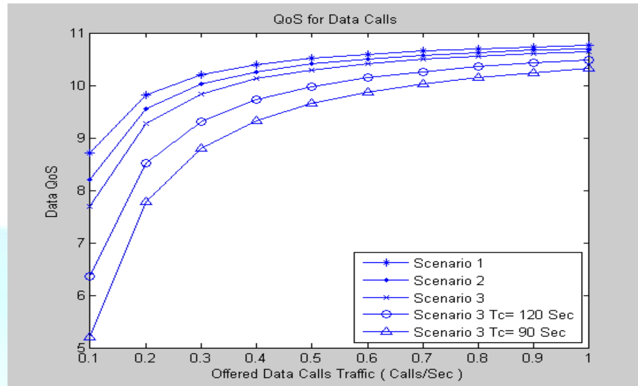
$$CT = \lambda_{h1}(1-P_{h1}) + \lambda_{h2}(1-P_{h2}) + \lambda_{h3}(1-P_{h3}) + \lambda_{hn1}(1-P_{n1}) + \lambda_{hn2}(1-P_{n2}) + \lambda_{hn3}(1-P_{n3}) \quad (5)$$

Simulated Result

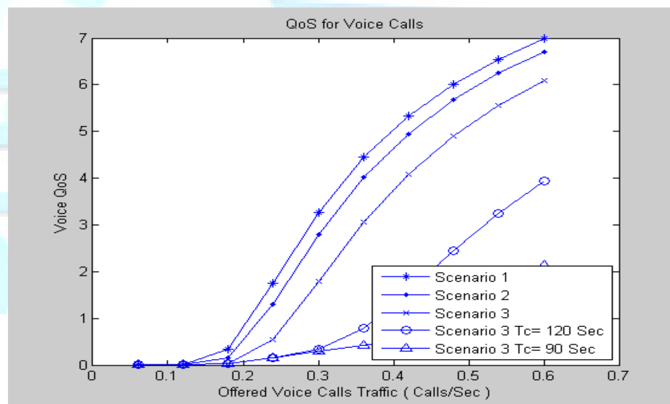
New calls and handoff calls are treated differently. Handoff calls are given higher priority to new calls, and load factor threshold for handoff calls and new calls are different. Handoff calls share residual capacity exclusively besides sharing available capacity with new calls. In simulation we consider the following three scenarios:

- Scenario1: All call services classes (new calls and soft handoff calls) are treated equally where they have the same load threshold and no queuing is used.
- Scenario2: Same as 1, and in addition to that, the handoff calls are allowed to be queued till the resource is available or the time out is reached.
- Scenario3: Same as 2, and in addition to that, the handoff calls have higher load threshold than new calls. This scenario is repeated using different channel holding times.

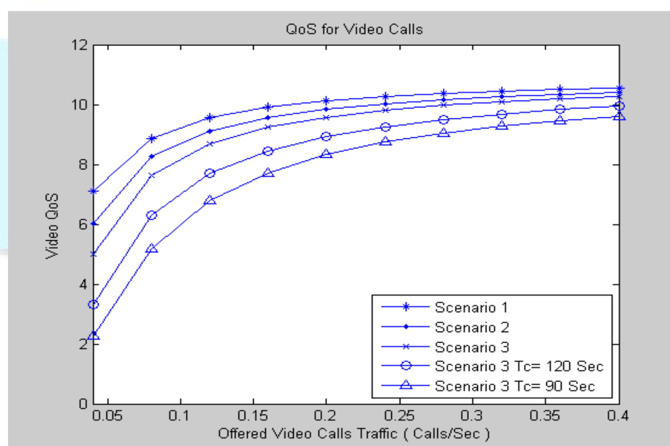
Average service time for all services is 180 seconds. Arriving rates of all services are changed. Scenario3 is repeated using different service times 120s and 90sec. It is clear that our proposed algorithm has better system capacity and this improvements increase as channel holding time decreases. In general as shown in these following figures, the system has a better performance under our planned algorithm.



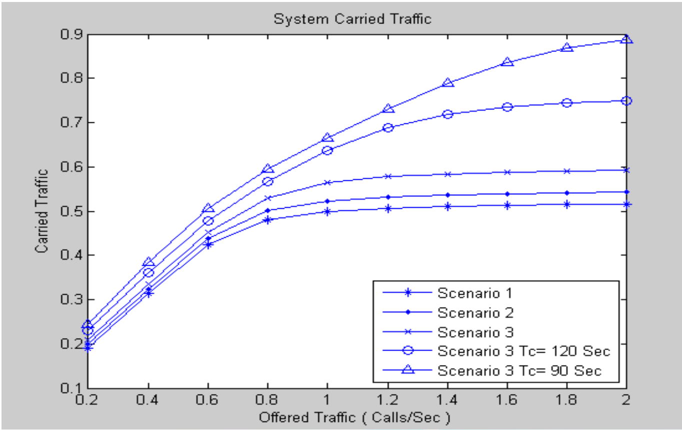
Graph 1:-QoS for Data calls



Graph 2:-QoS for Voice calls



Graph 3:-QoS for video calls



6-CONCLUSION

The concept of minimizing the call blocking probability is an optimization technique to provide fair QoS to the set of users in the wireless network and there is also a need of intelligent call admission control strategy in the admission control mechanism to make the decision of accepting are rejecting a call keeping the blocking probability minimal in a heterogeneous RATs based network working under dynamic network conditio

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